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Report

FINAL REPORT

on

AN ECONOMIC ANALYSIS OF
FIVE SELECTED LANDSAT ASSISTED
INFORMATION SYSTEMS IN OREGON
(Report No. BCL-OA-TFR-79-5)

by

S. Solomon and K.M. Maher

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FOREWORD

The study reported herein was carried out by Battelle's Columbus Laboratories for the NASA Office of Space and Terrestrial Applications, as a task under Contract No. NASw-2800. The work was done under the general supervision of Dr. A. C. Robinson, Battelle's manager for the contract. Task monitor in the Office of Space and Terrestrial Applications was Mr. Joseph A. Vitale.

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AN ECONOMIC ANALYSIS OF FIVE SELECTED LANDSAT ASSISTED INFORMATION SYSTEMS IN OREGON

By

S. Solomon and K.M. Maher

INTRODUCTION

The Environmental Remote Sensing Applications Laboratory (ERSAL) at Oregon State University has worked in close cooperation with public agencies in Oregon to develop information utilizing remote sensing technology. This information has been used as input to policy decisions affecting activities such as resource management, resource allocation, urban development, and agricultural practices. Although some participating agencies have contributed funds to help cover some of the cost incurred in obtaining the information, most of the financial support provided to ERSAL has been through grants made available by NASA.

The utilization of this information system by the various sponsoring agencies is a clear indication of the benefits derived out of such a system. However, it is to NASA's interest to know not only that the information system is beneficial, but also that it is comparatively economical and efficient over other systems.

The purpose of this study is therefore, to perform an economic analysis of five selected projects that were conducted by ERSAL, and determine their efficiency over alternative methods of obtaining similar types of information.

METHOD OF ANALYSIS

The direct application of traditional methods of cost-benefit analysis on candidate projects is not possible. This is because of the following distinctive characteristics of the projects under consideration:

(1) The projects involve new technologies, or information systems or ideas of doing things that are different from what has been done traditionally;

(2) The projects are not end products by themselves as far as the user of the information is concerned, they are in fact inputs to actions that lead to final input or end products;

(3) The contributions of the Landsat information systems to the total benefits of the projects arising from policy decisions are diffused and therefore difficult to isolate.

Consequently, each project was considered one at a time, and appropriate methods of economic analysis were identified.

In situations where the actual benefits of the Landsat-based information system are unobservable and difficult to assess, the alternative method for performing an economic analysis could be to employ comparative cost or a cost effectiveness analysis. This may be employed to provide a measure of the relative merits of the system under consideration. The objective is then to compare the cost of securing the Landsat-based information with the cost of an alternative technology which the user could employ to obtain a similar type of information had Landsat resources not been available. The relative difference in costs or the cost differential between the two alternatives would then provide a measure of the value or relative advantage/disadvantage of the system under consideration. This can be demonstrated and expressed mathematically as follows:

Let V_A and V_B represent the values of a Landsat-based information system and alternative conventional system, respectively. The monetary values of the discounted cash flow of each of the alternatives may be expressed as:

$$V_A = \int_0^\infty F_A\Big[Y_A(t)\ \partial_1(t) - C_A(t)\ \partial_2(t)\Big]\,dt > o \qquad (1)$$

$$V_B = \int_0^\infty F_B\Big[Y_B(t)\ \partial_1(t) - C_B(t)\ \partial_2(t)\Big]\,dt > o \qquad (2)$$

where $Y_A(t)$ and $Y_B(t)$ are benefit functions, $C_A(t)$ and $C_B(t)$ are the cost functions and $\partial_1(t) = \partial_2(t) = e^{-rt}$ is a discount function that increases with time at a constant rate, where r is the discount rate or time value rate.

In a situation where the streams of benefits are observable and easy to estimate, equations (1) and (2) may be used to calculate the net present value of the stream of benefits from the two alternatives.

In a situation where the benefit streams are difficult to assess, or the differences in benefits between the two alternatives are judged to be insignificant, a cost-effectiveness analysis may be employed by comparing equations (1) and (2).

$$\int_0^\infty F_A\Big[Y_A(t)\ \partial_1(t) - C_A(t)\ \partial_2(t)\Big]dt > \int_0^\infty F_B\Big[Y_B(t)\ \partial_1(t) - C_B(t)\ \partial_2(t)\Big]dt \qquad (3)$$

Cancelling the benefit function from both sides of the inequality on the assumption that the benefits are the same for the two alternatives results in a comparison of the costs expressed by:

$$\int_0^\infty F_B\Big|C_B(t)\ \partial_2(t)\Big|\,dt > \int_0^\infty F_A\Big|C_A(t)\ \partial_2(t)\Big|\,dt \qquad (4)$$

rearranging terms we get

$$\int_0^\infty F_B\Big|C_B(t)\ \partial_2(t)\Big|\,dt - \int_0^\infty F_A\Big|C_A(t)\ \partial_2(t)\Big|\,dt > o \qquad (5)$$

Equation (5) states that for a given level of output, the relative difference in the cost of alternative B over A is some positive value.

Equations (1) through (5) are illustrations of the continuous nature of the cost and benefit streams. However, it is a common practice to use discrete function. For estimation purposes, equation (5) may be expressed using discrete cost and discrete discount functions as

$$C_B \cdot 1/(1+r)^n - C_A \cdot 1/(1+r)^m = w \ ; \quad m \neq n \quad ;$$

where r is the discount rate, and m and n are years of project life. The value of w will determine the relative advantage of the alternatives under consideration. If $w > o$, it could be concluded that alternative A is economically advantageous over alternative B for a given level of benefits. If $w < o$, then B is shown to be relatively better than alternative A. If $w = o$, quantitative analysis does not indicate an advantage of one alternative over another, and the decision to choose a particular alternative would then have to depend on other parameters that are outside of the benefit cost calculus.

PROCEDURE

Two sets of cost data were obtained on the following five projects:

(1) Morrow County Assessor's Office Project

(2) Tansy Ragwort Monitoring Project

(3) Spotted Owl Project

(4) Natural Area Preserves Advisory Committee Project

(5) Columbia River Water Policy Project

The first set of data was obtained from ERSAL. On each of the above projects, ERSAL provided the cost of Landsat-based information by year of activity broken down into salaries, other payroll expenses, services and supplies, travel, and overhead.

The second set of data was obtained from the sponsoring agencies. Through a personal interview, each agency was asked to identify an alternative method they would have used for obtaining a similar type of information had the Landsat-based information not been available.

The initial estimated costs for each of the projects were expressed in nominal dollars. For the purpose of aggregation and comparability, it was necessary to express the dollars of expenditure in constant dollars of a given base year. The year 1972 was selected as the base year; and, the implicit price deflator for the Gross National Product-Government Purchases of goods and services - State and local index was used as the deflator. Price deflators used for the years 1974-1979 are:

1972	=	100
1974	-	118.4
1975	-	129.7
1976	-	137.7
1977	-	148.5
1978	-	160.4
1979	-	168.5

The year 1974 was selected as the year of analysis. This would be the year that each agency is assumed to have authorized funds to be made available for the purpose of obtaining the information from ERSAL as well as from the alternative source. Regardless of when the project was started and completed, therefore, each project was discounted back to 1974. In other words, the present value of costs for each set of data was evaluated in the year 1974.

In order to calculate the discounted values a discount rate of 6 3/8 percent is used (This is the discount rate that is presently used by the Federal government on water projects). Finally, the discounted value of the Landsat-based information system was compared with that of the alternative system to quantitatively establish the relative cost effectiveness of the Landsat-based information system.

EMPIRICAL ANALYSIS

In this section, cost estimates of each of the five selected projects will be analyzed. The procedure for performing the economic analysis follows what was discussed in the methods and procedures sections discussed earlier.

The Morrow County Assessor's Office Project

The agricultural system in Morrow County was undergoing changes. The wide use of the center pivot irrigation system which started in 1975 was quickly replacing dryland agriculture. By 1978, a total of 64,000 acres of land have been brought under irrigation. Yearly increases of acreage were as follows:

Year	Date Registered	Number of Acres
1975	1/1/75	10,000
1976	1/1/76	15,000
1977	1/1/77	30,000
1978	1/1/78	9,000
Total		64,000

Assessed valuation of farmland also changed from $15/acre under dryland to $800-900/acre under irrigation.

The Morrow County Assessor's Office was not able to locate and record the number of irrigation circles as rapidly as they were being brought under use using conventional methods. To accomplish this, Landsat false color composites were used to map the location, sizes of irrigated lands in areas where many circular pivot irrigation systems were being installed each year. Multitemporal imageries were used to document the time of establishment, location and when these

fields were brought under production. The results led to the detection of 384 new irrigation circles which represented $40 million of new assessed valuation and $600,000 of tax revenue annually which led to an 18% reduction in property taxes.

The project took ERSAL two years (1976 and 1977) to complete at a total cost of $3,513. The schedule of expenditure is shown in Table 1. Using a discount rate of 6 3/8 percent, the present value of the cost of the project evaluated in 1974 was $2,211.68.

In the absense of Landsat resources, the county assessor's office would have used field surveys as an alternative method of recording the number of irrigation circles in place of each year. No sophisticated equipment is needed for the field survey. A base map, a pick-up truck and one field personnel is needed for data collection.

It was estimated that it would take one field worker earning a salary of $1,300 per month, 10 working days to completely field check 10,000 acres of land.

The individual performing the field work would be receiving annual salary as shown in the following salary schedule.

1975	$15,600.00
1976	16.536.00
1977	17,528.16
1978	18,579.85

This schedule has a built-in six percent yearly salary increase as allowed by the Oregon state legislature.

TABLE 1. ITEMIZED SCHEDULE OF EXPENDITURES FOR THE MORROW COUNTY ASSESSOR'S OFFICE PROJECT

Year	Salary	Other Payroll Expenses	Services and Supplies	Travel	Overhead	Total	Deflated 1972=100
1976	$1,447	217	475	167	686	2992	2,172.84
1977	235	35	145	0	106	521	350.84

Source: Environmental Remote Sensing Applications Laboratory, Oregon State University, Corvallis, Oregon, October 1979.

The cost per year for the scheduled field work is as follows:

1975	$1.429.00
1976	2,182.10
1977	4,446.07
1978	1,359.85

These cost figures when deflated by the GNP deflator for Government purchases of goods and services/state and local to 1972 constant dollars (1972 = 100) would be:

1975	$1,102.77
1976	1,584.68
1977	2,993.99
1978	847.79

Using a discount rate of 6 3/8 percent, the present value of the cost as evaluated in 1974 was $5,586.54. Comparing this cost with that of the Landsat system, the cost differential would be:

$5,586 - 2,211.68 = $3,374.86.

This would indicate that the Landsat information system is cost effective and that it would cost 2.53 times as much to obtain the information using the alternative method.

Tansy Ragwort Monitoring Project

Tansy ragwort is a noxious weed that has caused the loss of millions of dollars in income each year through the death of livestock and contamination of crops. Ragwort invades a wide variety of habitats including forest clearcuts, dry, wet, improved-pastures, cropland, and unimproved suburban areas. Due to this variety of habitats and the

great differences that exist in the way and intensity with which they are managed, there are several alternative methods required for controlling ragwort. The Oregon Department of Agriculture has been very instrumental in developing control measures, recommending control programs, and coordinating the control efforts. In the face of widely varying estimates of the infestation problem, the Department undertook the task of establishing a data base that could be used to better quantify the magnitude of the problem and that could be updated as necessary to judge the effectiveness of the various county programs.

Landsat MSS CCT's and low level color aerial photography were used to estimate the number of acres by county that are infected by the noxious weed, and the intensity of infestation by cover type, e.g., dryland pasture.

The project established an objective estimate of infestation that was developed in a consistant manner for all counties. The estimated infested acres was set at 3 1/2 million (previous estimates had gone as high as 9 million acres).

The inventory reveals critical problem areas and provides a bench mark for judging the effectiveness of control programs.

The project was conducted over a period of three years (1975-1977) and the cost to ERSAL was $82,366.00. These costs were covered by contributions made by the Oregon Department of Agriculture general funds, Pacific Northwest Regional Commission, the NASA University Affairs Program, and the NASA Ames Research Center in subcontract to ESL, Inc. An itemized schedule of expenditures is presented in Table 2.

TABLE 2. ITEMIZED SCHEDULE OF EXPENDITURES FOR THE TANSY RAGWORT PROJECT - LANDSAT ASSISTED

Year	Salaries	Other Payroll	Services and Supplies	Travel	Overhead	Total	Deflated 1972=100
1975	493	87	713	225	34	1,552	1,196.61
1976	24,313	4,334	32,997	2,117	1,466	65,226	47,368.19
1977	12,765	2,287	-	-	536	15,588	10,496.97

Source: Environmental Remote Sensing Applications Laboratory, Oregon State University, Corvallis, Oregon, October 1979.

The yearly expenditures discounted to 1974 at a 6 3/8 percent discount rate yield a present value of $51,706.

A field survey would be the alternative method that would be employed to obtain the needed information had Landsat resources not been available. There are 16 million acres of land to be covered. It takes 12 men one month to cover 500,000 acres. According to the project manager, a team of eight field men would be the desired size. Therefore, in a period of one month eight persons will be able to cover 333333.33 acres. To cover the 16 million acres, it would take the eight field men 48 months or four years. Because of weather conditions, the work can be performed for only six months in the year. It would therefore take eight years to complete the survey.

The planning horizon of the project is 1974-1981. Each year two million acres of land would be surveyed. The major cost items, including payroll for field personnel, travel allowance, and vehicle rental, were estimated at $58,200 in 1979, which is equivalent to $34,540 in 1972 dollars. Assuming the same level of effort would be required in each of the eight years of survey effort, these major cost items are as shown in Table 3. Additional expenses would be incurred at the conclusion of the effort for compilation and clerical work; this expense is included in the 1981 expenditures.

At a discount rate of 6 3/8 percent, the present value of the cost of the alternative information system at the planning year of 1974 is $228,262. When this value is compared to the cost of the Landsat-based information system, the cost differential is $228,262 - $51,706 = $176,556. In other words, the alternative field survey method of data collection is 4.41 times expensive as the one obtained from the Landsat system. The Landsat system is cost effective by a ratio of 4.41 versus the alternative system.

TABLE 3. ITEMIZED SCHEDULE OF EXPEDITURES FOR THE TANSY RAGWORT MONITORING PROJECT - FIELD SURVEY

Year	Payroll (1979 $)	Travel (1979$)	Vehicle Rental (1979$)	Maps (1979$)	Air Survey (1979$)	Clerical/ Compilation (1979$)	Total (1979$)	Deflated 1972=100
1974	33,600	22,080	2,520	208	700	-	59,108	35,078.92
1975	33,600	22,080	2,520	-	-	-	58,200	34,540.06
1976	33,600	22,080	2,520	-	-	-	58,200	34,540.06
1977	33,600	22,080	2,520	-	-	-	58,200	34,540.06
1978	33,600	22,080	2,520	-	-	-	58,200	34,540.06
1979	33,600	22,080	2,520	-	-	-	58,200	34,540.06
1980	33,600	22,080	2,520	-	-	-	58,200	34,540.06
1981	33,600	22,080	2,520	-	-	7,560	65,760	39,026.71

Source: Personal interview estimated by Dennis Isaacson, Environmental Remote Sensing Applications Laboratory, Oregon State University, Corvallis, Oregon, September 1979.

Spotted Owl Project

The spotted owl, an endangered species and a native of Western Oregon prefers as its nesting tree old growth of mature Douglas fir with broken snag tops. The Douglas fir, because of its high timber value has been subject to more intensive commercial logging activity than any other forest type in Western Oregon. The various land management agencies such as the Bureau of Land Management, maintain rotational timber programs that would remove all old growth timber stands in 30-40 years. These commercial activities would potentially reduce the spotted owl population to the endangered species level, at which time all federal agencies would have to stop all activity to any area occupied by the spotted owl.

In order to reach a balance where spotted owl habitats would be maintained without completely suspending the logging of timber, a task force was formed that would study and recommend policy on logging activities in the vicinity of the owls habitat.

In order to make an inventory of the old growth Douglas fir stands, the task force sought ERSAL's help in obtaining Landsat False Color Composites and NASA color infrared high flight photography.

The task took approximately one month to complete. The total cost of the project was $1,092.50. This included $500.00 salary for one person, $450.00 for equipment and analysis, and $142.50 of overhead.

In the absence of the Landsat services, the alternative method to be employed would be visual searching of aerial photographs and forest maps that have been prepared for tax purposes. The project would take six months to complete with a lumpsum cost of $3,200.00

The information obtained on the Spotted Owl project is very scanty and the cost comparisons should be considered tentative. However, even with the data limitations, the Landsat information seems to have a definite cost advantage over the conventional method (cost differential $2,107.5). The ratio of the Landsat system cost to the conventional system is in the order of 1:2.93.

Natural Area Preserves Advisory Committee (NAPAC) Project

The Oregon State Land Board established the Natural Area Preserves Advisory Committee to select those parcels of Oregon state-owned lands that are to be considered for natural area preserves. The task required making an inventory of all state-owned land in all of Oregon's 36 counties and determining those undisturbed parcels containing a large variety of natural ecosystems. NAPAC obtained the help of ERSAL to use NASA high flight color infrared photography for a vegetation-resource inventory of all state-owned lands in Oregon. ERSAL has completed the survey of all State-owned land in Oregon in the search for natural areas which are suitable for consideration for preserves.

The project was started in 1974 and completed in 1978. The total cost of the project was estimated at $27404.70. An itemized schedule of expenditure is presented in Table 4. The total cost of the project expressed in constant 1972 dollars is $19773.21. The present value of the cost of the project discounted at a discount rate of 6 3/8 percent evaluated at the begining of 1974 is $17,540.03.

In the absence of ERSAL resource, the advisory Committee would have acquired the needed information using field survey methods. The task would be performed in three phases for each of the 36 counties of Oregon that are to be checked.

The first phase involves the acquisition of Base maps that show ownership information. Using these maps, conduct meetings with administrators of state land to determine if it is disturbed or grazed. This task would take two persons each earning a salary of $1000.00/month, one week for each county.

TABLE 4. ITEMIZED SCHEDULE OF EXPENDITURE FOR THE NATURAL AREA PRESERVES ADVISORY COMMITTEE PROJECT

Year	Salaries	Other Payroll	Overhead	Services and Supplies	Travel	Total	Deflated 1972 = 100
1974	2,979.82	201.90	1.77	-	-	3,183.49	2,688.76
1975	3,925.16	358.31	64.31	206.09	959.93	5,513.80	4,251.20
1976	4,187.22	569.28	2,218.79	313.60	1,021.61	8,310.50	6,035.22
1977	3,218.61	448.68	825.43	168.29	1,667.31	6,328.32	4,261.49
1978	2,497.99	413.97	531.55	500.45	124.58	4,068.54	2,536.50

Source: Environmental Remote Sensing Applications Laboratory, Oregon State University, Corvallis, Oregon, October 1979.

The second phase involves ground truthing, by driving in each county and assessing the sites in the field. Besides the salary of the field personnel, additional costs of travel would be incurred. The task would require four weeks per county for one person driving 3000 miles at a mileage cost of 15¢ per mile.

The third phase involves compilation of the data that has been collected. It takes two weeks of staff time and a secretary on a quarter time basis, per county. Salaries to the secretary would be $800/month. Thus, for each county in 1974 the total would be $600.

The task can not be performed on each of the 36 counties one after another. It is efficient to group the counties and do the survey in a sequence. Ideally, six counties can be analyzed in one year. The schedule of activities would be as follows.

Year	Region	# of Counties
1974	Southwestern Oregon	2
	Southeastern Oregon	3
1975	Northeastern Oregon	7
1976	North Coastal	6
1977	South Coastal	3
	Central	3
1978	Central	4
	Willamette	2
1979	Willamette	6
TOTAL		36

According to this schedule, the cost per calendar year is estimated as follows, assuming salary costs increase 6 percent annually:

Year	Cost $	Deflated 1972 = 100
1974	12,750.00	10,768.58
1975	18,732.00	14,442.56
1976	16,854.00	12,239.65
1977	17,706.78	11,923.76

Year	Cost $	Deflated 1972 = 100
1978	18,607.20	11,600.50
1979	19,561.50	11,609.20

The life of the project extends over the period 1974-1979. When evaluated at the begining of the project year 1974, the present value of the project cost discounted at 6 3/8 percent discount rate amounts to $63,863.62.

Comparing this preset value of project cost to that of the Landsat-based system, the cost differential is:

63,863.62 - 17,540.03 = $46,323.59.

The field survey method of obtaining the needed information costs 3.64 time as much as it cost ERSAL to obtain a similar type of information. The LandSat-based information system is therefore cost effective by a ratio of 1:3.64 aginst the alternative system.

Columbia River Water Policy Project

The Oregon Water Policy Review Board was mandated by the legislature to formulate a coordinated and integrated state water resources policy and also to provide for the enforcement of those policies. This was prompted by the tremendous increase in the demand for water from 1973 through 1975 in portions of the Columbia River Basin due to the establishment of over 300 circular pivot irrigation systems. The Review Board required the Oregon Water Resources Department to gather the information that would provide the necessary baseline data. This included the location, size and number of existing irrigated lands. To accomplish this objective ERSAL's resources were used to obtain photointerpretation of NASA U-2 color infrared aerial photography and multiseasonal Landsat color composites. The project started in January 1977 and was completed in June of the same year.

The Landsat assisted method of landuse mapping was performed in the following production step:

Production Step

1. Delineate area to be mapped.

2. Contact state, federal and local agencies to determine what mapping is in existence.

3. Select land use classifications to be mapped.

4. Visit ERSAL to determine what U-2 and LANDSAT coverage is available.

5. Perform land use mapping at ERSAL. Map land use from U-2 photography and up-date to selected data utilizing LANDSAT imagery.

6. Measure acreages of various land use classifications and tabulate.

7. Field check land use mapped in ERSAL.

8. Prepare land use map for agency use and report.

The level of effort and expenses for performing each of the production steps is detailed in Table 5. As shown in Table 5, the total cost of the project was $12,706.95. In constant 1972 dollars, this is equivalent to $8,556.87. Evaluated from a time frame in 1974, the present value of the project cost at 6 3/8 percent discount rate is $7,109.

In the absence of a Landsat assisted method of obtaining the information, the Oregon Water Resources Department would have performed a field mapping method using aerial photography. The task would be performed according to the following production steps.

Production Steps

1. Delineate area to be mapped.

2. Contact state, federal and local agencies to determine what mapping is in existence.

3. Select land use classifications to be mapped.

4. Purchase aerial photography for field mapping.

TABLE 5. LAND USE MAPPING FOR WATER POLICY FORMULATION (LANDSAT-ASSISTED METHOD)

	LABOR					SUPERVISION	LABOR AND SUPERVISION	EXPENSES		GRAND TOTAL
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
PRODUCTION STEP	MAN HRS	HRLY RATE	TOTAL	OPE	TOTAL	@15% OF LABOR	(6) & (7)	TRAVEL	MATERIAL	(8)&(9)&(10)
1	32	6.87	219.84	36.05	255.89	38.38	294.27		131.25	425 52
2	16	6.87	109.92	18.03	127.95	19.19	147.14			147.14
3	8	6.87	54.96	9.01	63.97	9.60	73.57			73.57
4	8	6.87	54.96	9.01	63.97	9.60	73.57	16.50		90.07
5	416	6.87	2,857.92	468.70	3,326.62	498.99	3,825.61	447.20		4,272.81
6	400	6.87	2,748.00	450.67	3,196.67	479.80	3,678.47			3,678.47
7	120	6.87	824.40	135.20	959.60	143.94	1,103.54	678.75		1,782.29
8	240	6.87	1,648.80	270.40	1,919.20	287.88	2,207.08		30.00	2,237.08
										12,706.95

Source: Supplied by Mr. Bud Bartells, Oregon Department of Water Resources, Salem Oregon, September 1979.

5. Perform field mapping. (includes delineation of classifications and ground control.)

6. Measure acreages of various land use classifications and tabulate.

7. Prepare land use map for agency use and report.

The level of effort and production expenses are detailed in Table 6. The project would have taken one and one-half years to complete. This would have started at the begining of 1977 and ended in the middle of 1978. The total cost of the project is estimated at $24,804.91. Expressed in constant 1972 dollars, this would amount to $15,464.41.

If the project was considered for funding in 1974, the present value of the project discounted at 6 3/8 percent discount rate would be $13,279.00.

The cost differential between the Landsat assisted method and the alternative is $13,279 - $7,109 = $6,170 in favor of the Landsat system. Alternatively, the Landsat assisted method of obtaining the information costs only 53.5 percent of what it would cost if another method was used, yielding a ratio of 1:1.87.

TABLE 6. LAND USE MAPPING FOR WATER POLICY FORMULATION

EXISTING METHOD

LABOR						SUPERVISION	LABOR AND SUPERVISION	EXPENSES		GRAND TOTAL
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
PRODUCTION STEP	MAN HRS	HRLY RATE	TOTAL	OPE	TOTAL	@15% OF LABOR	(6) & (7)	TRAVEL	MATERIAL	(8)&(9)&(10)
1	8	6.87	54.96	9.01	63.97	9.60	73.57			73.57
2	16	6.87	109.92	18.03	127.95	19.19	147.14			147.14
3	8	6.87	54.96	9.01	63.97	9.60	73.57			73.57
4	16	6.87	109.92	18.03	127.95	19.19	147.14		7,000.00	7,147.14
5	800	6.87	5,496.00	901.34	6,397.34	959.60	7,356.94	4,091.00		11,447.94
6	400	6.87	2,748.00	450.67	3,198.67	479.30	3,678.47			3,678.47
7	240	6.87	1,648.80	270.40	1,919.20	287.86	2,207.08		30.00	2,237.08
										24,804.91

Source: Supplied by Mr. Bud Bartells, Oregon Department of Water Reosurces, Salem, Oregon, September 1979.

SUMMARY AND CONCLUSIONS

A comparative cost analysis was performed on five Landsat-based information system. In all five cases, the Landsat system was found to have cost advantages over its alternative.

The information sets generated by Landsat and the alternative method are not identical but are comparable in terms of satisfying the needs of the sponsor. The information obtained from the Landsat system in some cases is said to lack precision and detail. On the other hand, it was found to be superior interms of providing information on areas that are inaccessible and unobtainable through conventional means. There is therefore a trade-off between precision and detail, and considerations of costs.

In all of the five projects examined, the Landsat assisted method cost the sponsor less, and, the information took less time to gather. The Quantitative analysis clearly demonstrates the cost effectivenss of the Landsat assisted method. A summary of the discounted cost of each system is presented in Table 7.

TABLE 7. SUMMARY OF COST COMPARISONS ON FIVE SELECTED PROJECTS HANDLED BY ERSAL (1972 $)

Project Name	Present Value of Cost in 1974		Cost Differential	Ratio of Costs Landsat: Alternative
	Landsat	Alternative		
Morrow County Assessor's Office Project	2,211	5,586	3,375	1:2.53
Tansy Ragwort Monitoring Project	51,706	228,262	176,556	1:4.41
Spotted Owl Project	1,092	3,200	2,108	1: 2.93
Natural Area Preserves Advisory Committee Project	17,540	63,863	46,323	1: 3.64
Columbia River Water Policy Project	7,109	13,279	6,170	1:1.87

NOTE: Cost items appearing in this table are in Constant 1972 dollars.

LIST OF CONTACTS

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2. Morrow County Assessors Office Project - Person contact made at Hepner Oregon

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3. Tansy Ragwort Monitoring Project

   Dennis Isaacson - Corvallis, Oregon

4. Spotted Owl Project

   Glenn Guday - (Telephone Contact)
   Institute of Northern Forestry
   Fairbanks, Alaska

5. Natural Area Preserves Advisory Committee

   Robert Frankle - Dept. of Geography
   Oregon State University
   Corvallis, Oregon

6. Columbia River Water Policy Project

   Bud Bartells
   Oregon Water Resources Department
   Salem, Oregon

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